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AUTHOR	Matthews, Charles C.; Phillips, Darrell G.
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ABSTRACT

Described are Science Curriculum Assessment Study (SCAS) techniques and instruments and how they are applied to children and teachers. SCAS is a system for monitoring changes (in children and their teachers) associated with the classroom implementation of a variety of science curricula. SCAS combines the interview techniques and theories of Jean Piaget with the techniques of classroom interaction analysis. SCAS provides a system for studying the intellectual development of children, classroom verbal and non-verbal behavior of children and their teachers, and various elements of the science curriculum. Persons interested in depth study of research and theories associated with SCAS techniques and instruments will find the bibliography useful. (BR)

HANDBOOK FOR THE APPLICATION OF THE SCIENCE CURRICULUM ASSESSMENT SYSTEM

Darrell G. Phillips
Science Education Center
University of Iowa
Iowa City, Iowa

Charles C. Matthews
Department of
Science Education
Florida State University
Tallahassee, Florida

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Preface

All research and development associated with the Science Curriculum Assessment System were performed by the authors of this handbook. The planning and writing of this handbook for the application of SCAS were cooperative in that both authors contributed ideas to its organization, design, and content.

The development of the SCAS Interaction Analysis Categories and the SCAS Classroom Observational Techniques has been the work of Charles C. Matthews. The development of the SCAS Interview Techniques and the design of the SCAS Interview Protocols has been the responsibility of Darrell G. Phillips.

Darrell G. Phillips May, 1968 Charles C. Matthews

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Handbook for the Application of

the

Science Curriculum Assessment System

I. Purpose

Because we are becoming increasingly aware of the importance of science and early school experiences in science, tremendous effort and financial expenditure are going into curriculum reform in science at the elementary school level. Supported largely by the National Science Foundation, scientists and educators have cooperated during recent years in developing materials and programs for elementary school science teaching. The impact of materials and programs developed by the American Association for the Advancement of Science, Elementary Science Study, Science Curriculum Improvement Study, etc., has not been systematically assessed. Data are not available on the extent to which elementary school science teaching and learning have been altered by these and other recent federally-supported programs.

Although efforts have been made at evaluating the new elementary school science programs, there has been no uniform system available for monitoring changes associated with the implementation of science programs. It is especially unfortunate that we have not contrasted existing programs with new programs in terms of behaviors of children and teachers or in terms of the intellectual development of the children. It is equally unfortunate that we have not contrasted one new program with another.

Many science programs have been evaluated by various means during their development with little or no attention to changes in the classroom behaviors of teachers of the programs and with little attention to the day-to-day classroom behaviors of the children. Little or no program evaluation has been directed toward investigating changes in the child's intellectual development as measured by his interpretation of the physical environment; and this should be the ultimate criterion for determining the value of a science program.

Numerous researchers are applying the techniques of interaction analysis (developed by Flanders and others) to the study of changes in classroom behaviors of teachers and children and countless children are being studied (utilizing adaptations of Piaget's techniques) in an effort to identify logical operations associated with their interpretations of their environments. However, little or no work has been directed toward associating classroom behaviors with the child's interpretation of his environment.

SCAS is a system for monitoring changes (in children and their teachers) associated with the classroom implementation of a variety of science curricula. SCAS combines the interview techniques and theories of Jean Piaget with the techniques of classroom interaction analysis. SCAS provides a system for studying the intellectual development of children, classroom behaviors of children and their teachers, and various elements of the science curriculum.

This handbook is intended to describe SCAS techniques and instruments and how they are applied to children and teachers. Persons interested in depth study of research and theories associated with these techniques and instruments will find the bibliography useful.

II - Obtaining Information from Children and Teachers

A. Obtaining Information from Children by Individual Interviews

Individual Interviews vs. Paper and Pencil Tests

The SCAS individual interview is based upon two fundamental assumptions: (1) traditional methods of obtaining information from children (IQ tests, mental age tests, achievement tests, etc.) do not permit an in depth examination of how the child views his environment or of the child's ability to use logical thinking; and (2) Piaget-type tasks do provide the best possible means of obtaining such information.

In order that SCAS be effective, the child's interpretation of his environment must be rigorously recorded. Individual interviews of the type prescribed for SCAS permit collection of data in the most unambiguous way. The interviewer works with a child, asks questions, presents problems, and then makes observations as to the child's behaviors and his verbal responses. From these observations inferences can be drawn as to how the child interprets his environment.

Paper and pencil tests, on the other hand, provide data which are highly suspect -- did the child copy? did he guess at a response? did he base his answer on some memorized but not understood bit of information? etc. In addition to these faults, paper and pencil tests do not permit evaluation of the child's ability to use logical thought in his approach to a problem, therefore these tests do not fulfill the necessary requirements for SCAS.

The Type of Individual Interviews Used in SCAS

Interviews used in SCAS are closely related to those used by the Swiss scientist and epistemologist, Jean Piaget. This man, perhaps more than any other, is having increasing influence on the school curriculum of today.

Jean Piaget is presently Director of the Rousseau Institute, the International Center of Genetic Epistemology, and the International Bureau of Education. In addition, he is a professor of child psychology at the University of Geneva. Piaget has devoted more than forty of his seventy-one years to the study of the development of intelligence in the human being, and he is still actively pursuing this research today.

Ten years ago the work of Piaget was relatively unknown in this country, but with the publication of The Process of Education, by Jerome Bruner (1), this situation was changed. Bruner's book was the direct result of a conference held at Woods Hole, Massachusetts, where thirty-five scientists, scholars, and educators gathered to discuss ways in which science education

might be improved in elementary and secondary schools. Barbel Inhelder, a close associate of Piaget, had been invited to the conference and spoke to the committee about the implications of Piaget's work for curriculum development. Since the advent of this important book, Piaget's influence upon education in this country has increased steadily.

The work of Piaget and his colleagues has influenced the development of recent elementary school science materials. The Science Curriculum Improvement Study (SCIS) and the Minnesota Mathematics and Science Teaching Project (MINNEMAST) have acknowledged this influence (2,3), and at least one elementary school science textbook series (4) and one kindergarten pre-number book (5) have derived their basis from Piaget's work. In addition, articles in such publications as Grade Teacher (6,7), and The Science Teacher (8), and finally, a recent article in Saturday Review (9) attest to the growing number of individuals who are concerned with what Piaget has discovered in his work with children.

What is so unusual about this man's work? Why so much emphasis here? These questions are indeed valid, and there are several factors that contribute to such emphasis, but one factor stands out above all others: Piaget and his colleagues have performed and reported an almost overwhelming amount of research with children. In addition, independent investigators have replicated many of Piaget's studies in all parts of the world, and most of these studies have given support to Piaget's findings. This point cannot be over-emphasized. There is no other coherent body of research of this magnitude that supports a specific developmental theory of intelligence. This research does not consist of animal studies, written tests, or any of the other usual procedures, but it has been done in individual interviews with children -- not just a few children, but thousands of children.

A second factor that contributes to the interest in Piaget's work is found in the experiments themselves. Piaget typically studies children in a one-to-one interview by posing some task or problem for the child to perform. It is in the design of these tasks that Piaget's genius becomes evident. The child, in performing the task, is usually led to reveal how he views a segment of his environment. Many of these tasks deal with such science-related concepts as length, number, area, volume, speed, time, and weight, to mention only a few, and this is why Piaget's work has made a greater impact on science education than other areas of education (10). For further reading on Piaget's developmental theory of intelligence and examples of numerous tasks, the reader is referred to an excellent book by Flavell (11).

Piaget utilizes the tasks that he gives children to demonstrate and evaluate the particular intellectual level at which that child can perform. The Piaget-type tasks utilized in SCAS are similarly designed in that they will be employed to investigate a child's interpretation of his environment and his ability to utilize logical thought.

Piaget presents tasks to children in a very open-ended type of presentation, that is, the interviewer is allowed a great deal of freedom to pursue various avenues of thought. Piaget calls this type of presentation the "clinical method" of task presentation. Tasks presented to children by means of the clinical method suit Piaget's purposes well in that they allow the investigation of the child's intellectual development over a broad range of concepts.

The form of the individual interview employed in SCAS is not identical to the clinical method employed by Piaget. Since SCAS is designed to sample the way in which a child looks at a particular part of his environment, the interview technique utilized is much more restricted and is not as open-ended as in the clinical method. Therefore, to avoid confusion, the type of individual interview employed in SCAS will be referred to as the "experimental method" of task presentation. Again, the primary difference between Piaget's clinical method and the SCAS method of task presentation is that the SCAS interviews employ prescribed protocols and are therefore more restricted than a true Piaget interview.

General Procedures for SCAS Individual Interviews

The specific tasks utilized in this preliminary edition of SCAS are outlined in detail in Chapter III of this handbook. There are, however, some general procedures for administering tasks that can be discussed at this point.

Piaget has written at length about the clinical method of task presentation and a great deal of what he has written applies to the experimental method of task presentation employed in SCAS. The following excerpts are taken from The Child's Conception of the World, by Jean Piaget (11).

"Moreover, it is our opinion that in child psychology as in pathological psychology, at least a year of daily practice is necessary before passing beyond the inevitable fumbling stage of the beginner. It is so hard not to talk too much when questioning a child, especially for a pedagogue! It is so hard not to be suggestive! And above all, it is so hard to find the middle course between systematisation due to preconceived ideas and incoherence due to the absence of any directing hypotheses! The good experimenter must, in fact, unite two often incompatible qualities; he must know how to observe, that is to say, to let the child talk freely, without ever checking or side-tracking his utterance, and at the same time he must constantly be alert for something definitive, at every moment he must have some working hypothesis, some theory, true or false, which he is seeking to check. To appreciate the real difficulty of the clinical method one must have taught it. When students begin they either suggest to the child all they hope to find, or they suggest nothing at all, because they are not on the look-out for anything, in which case, to be sure, they will never find anything.

In short, it is no simple task, and the material it yields needs subjecting to the strictest criticism. The psychologist must in fact make up for the uncertainties in the method of interrogation by sharpening the subtleties of his interpretation. But, here again, the beginner is threatened by two opposing dangers, those of attributing either its maximum or its minimum value to everything the child says. The greatest enemies of the clinical method are those who unduly simplify the results of an interrogatory, those who either accept every answer the child makes as pure gold or those on the other hand who class all as dross. The first, naturally, are the more dangerous, but both fall into the same error, that is, of supposing that everything a child may say, during a quarter, half or three-quarters of an hour of conversation, lies on the same psychological level -- that of considered belief, for example, or of romancing, etc.

The essence of the clinical method is, on the contrary, to separate the wheat from the tares and to keep every answer in its mental context. For the context may be one of reflection or of spontaneous belief, of play or of prattle, of effort and interest or of fatigue; and above all there are certain subjects who inspire confidence right from the beginning, who can be seen to reflect and consider, and there are others of whom one feels equally certain that they pay no heed to the questions and only talk rubbish in their replies."

Piaget believes that one should train daily for a period of one year before giving tasks to children. It is obvious that participants in SCAS do not have the time for this extensive preparation, but it should be kept in mind that interviewers using the SCAS method of task presentation have prescribed protocols by which they work, and they do not require such lengthy training.

"Intelligence" and SCAS

Here, perhaps, intelligence should be defined in the context of SCAS. The authors are not in the least concerned with the type of intelligence that is handed in on a piece of paper at the end of a twenty-minute quiz. This intelligence is usually superficial, and there is little evidence upon which to base inferences about the child's thinking.

The authors of SCAS are concerned with the kind of intelligence that is an integral part of the child; intelligence in the sense that the child has structured or can structure it into his own mental content; the kind of intelligence that you, as an adult, have at your disposal at this instant, with no chance to "cram." What questions may we ask you about your environment? What do you know about the environment when certain objects are manipulated in particular ways? What knowledge do you have at your immediate disposal that you feel sure of, that you do not feel is composed of memorized facts?

John Holt, in How Children Fail (12), has defined intelligence in a way that is completely compatible with SCAS:

> The true test of intelligence is not how much we know how to do, but how we behave when we don't know what to do. (p. 165)

B. Obtaining Classroom Data from Children and Teachers

Whether one is developing a curriculum or attempting to monitor implementation of a well established curriculum, it is important to collect information from teachers and children in the natural environment of teaching and learning. It is inconceivable that any curriculum should be evaluated or that any curriculum should be developed in the absence of systematic and objective classroom data collection. However, systematic collection of data in the classroom has been slow in coming. It is apparent that classroom data collection involving observation of teaching has a much longer history than data collection involving systematic observation of teaching.

The early period through the 1920's and 1930's saw the use of rating scales in most research involving direct observation of teachers. Research results in which rating scales were used are viewed by Medley and Mitzel (14,15) as providing "uniformly negative results" due to lack of uniformity in evaluative criteria.

With the pioneer work of Moreno (16) and the subsequent efforts of Jennings (17,18) the promise of the sociometric approach focused classroom research on the student rather than the teacher. A concurrent development was a trend toward specifying and quantifying only selected aspects of the teacher's classroom behavior. This technique is much in evidence in current research and involves observation and categorization of classroom behaviors. The work of Johnson (19) and the subsequent work of Anderson (20,21) represent further landmarks in developing categories for quantitatively describing teachers' verbal behaviors in classrooms.

Lippitt (22) and Withall (23) suggested that the main direction of influence in the classroom is from teacher to learners. Although this viewpoint has been modified somewhat by Gold (24) and Thelen (25), research emphasis has focused primarily on the teacher-pupil observable verbal communication.

The area of classroom behavior receiving most emphasis in direct observation research, and the area in which observation has been applied most successfully, is that referred to as "classroom climate" (15). Flanders (26) is responsible for the development and research use of what appears to be a useful technique for observing classroom climate. This system assumes verbal interaction between the teacher and pupils to be an adequate sample of teacher classroom behavior and has successfully distinguished among various "classroom climates." It is unique in preserving information regarding the sequence of verbal behavioral categories as well as the frequency and amount of time devoted to each category. The dimension of verbal interaction to which the Flanders System is directed has to do with "directness of teacher influence."

Medley and Mitzel (15) summarized several sets of verbal interaction categories and systems of analysis. They suggested that the classroom behavioral dimension which is called "classroom climate" has been investigated successfully under various names in different projects. Such terms as dominative-integrative, teacher-centered versus learner-centered, hostile-supportive, direct-indirect influence and others are said to be highly similar (or even identical) dimensions of behavior, which are reliably measurable and important in the development of educational theory. The summary further asserts that verbal behavior has been measured more successfully than any other dimension of classroom behavior.

A recent investigation of the classroom verbal behavior of high school physics teachers by Snider (27) identified relationships between teacher-pupil verbal interaction and "effectiveness" in teaching high school physics.

In recent years interaction analysis has been used as a tool in studying the student teaching experience. One such study reported by Wilk and Edson (28) indicated that in the lower grades student teachers are more likely to exert "direct influence" on pupils and in the upper elementary school grades the student teachers are more likely to exert "indirect influence." Matthews (29) and McLeod (30) have used Flander's categories to determine some verbal behaviors in which the cooperating teacher exerts an influence on the behavior of the student teacher.

Smith (31) advocated and effected a shift in emphasis from the affective to the cognitive aspects of classroom behavior. Others (32, 33,34,35) followed his lead. The work of Smith, Meaux and their associates (36) has produced a detailed classification system consisting of thirty-five categories of "logical operations of teaching." These "logical operations" include designing, designating, classifying, and others. Aschner (32) and Gallager (33) adapted Guilford's "structure of intellect" model (36) and focused on the verbal responses of gifted students to infer and classify thought processes. The five major categories included are cognitive-memory, convergent thinking-divergent thinking, evaluative thinking, and "routine." Bellack (35) classified classroom discourse into what he refers to as "pedagogical moves" (which he identifies as soliciting, structuring, responding, and reacting). Bellack's group also simplified Smith's thirty-five categories of logical operations by collapsing them to seven. It is unfortunate that the group of classroom interaction analysts who have focused on the cognitive aspects of classroom behavior have not taken full advantage of the tremendous power of matrix analysis. It is obvious that most attention has been given to teacher behaviors in the classroom and relatively little attention has been given to detailed analysis of the influence of teacher behaviors on the behaviors of children. Even less attention has been devoted to examination of the influence of child behaviors on behaviors of the teachers.

Taba (37) has analyzed typescripts which were prepared from tape recordings of elementary school teaching sessions. She found the number of pupils participating in class discussions ranged from 33% in one class to 100% in another. Her data also showed that pupils who produced the most "thought units" also produced the most "higher levels" of thought.

More recently Parakh (38) has developed a set of sixteen major categories (with twenty-eight sub-categories and a "residual" category) which are designed to describe the classroom behaviors of high school biology teachers. The Flander's System of Analysis was applied to these categories and a 16-by-16 matrix was computed to describe teacher-pupil interaction. Studying ten biology teachers in central New York, Parakh found that about 75% of biology "lecture" was devoted to teacher talk, while teacher talk consumed about 50% of the time in "laboratory sessions." Teachers exhibited non-verbal behaviors about 10% of the total time in "lectures" but almost 40% of the time in "laboratory sessions."

From the research described above it seems obvious that no general theory of classroom behavior has yet been formulated. Medley and Mitzel (15) state that a theory of classroom behavior depends upon: (1) developing methods of quantifying classroom behaviors and (2) collecting a large body of measurements of behaviors using these methods. The means of quantifying classroom behaviors have been developed and are being used as indicated above. However, that the "large body of measurements of behavior using these methods" has not been assembled is emphasized by Cogan (39), who states that "we do not have adequate data for the analysis of the behavior of the teacher."

Although the research of Flanders (40,41,42,43,44) has made a rather impressive case for the assumption that the verbal behavior of the teacher is an adequate sample of his total behavior, Parakh (38) has questioned this assumption particularly as it relates to science teaching. It is obvious that, if one is to study activity-oriented elementary school science programs, the assumption that verbal behavior is an adequate sample of classroom interaction must be seriously questioned.

If one accepts the view that teaching is a special case of social interaction directed primarily toward the achievement of selected educational objectives, then it becomes important to identify the individual in the classroom who plays the dominant role in influencing behaviors of others. It is obvious that in classrooms the teacher influences (to the point of dictating) the kind of interactions which take place. The teacher exercises control over the information which he presents, the activities in which students engage, and the manner in which students engage in the activities. The teacher decides whether he will ask questions, give information, give specific directions, observe students, or respond to students. If the teacher decides to respond to student behaviors it is his decision as to how he will respond to students -- with

acceptance or encouragement, with suggestions or alternatives, with rejection or discouragement or with severe reprimands intended to immediately terminate certain student behaviors.

Even though it is frequently the teacher who is the major determinant of pupil classroom behaviors, it is obvious to the experienced classroom observer that a great variety of pupil behaviors are exhibited -- frequently even by one child. However, if one systematically and objectively focuses his attention on different children in the classroom, it becomes obvious that a wider range of pupil behavioral patterns may be identified and that these patterns vary from one child to another. Some children exhibit primarily behaviors associated with careful attention to teachers and meticulous application to the teachers' directions. Other children predominantly do not follow specific directions of the teacher but devise their own manner of engaging in classroom activities. Some children frequently initiate interaction with the teacher while other children are more likely to initiate interaction with fellow students. Some students are receivers of ideas both from the teacher and from other children while other children predominantly are givers of ideas to other children and to the teacher. Some children are copiers of the behaviors of fellow students as well as copiers of certain behaviors of their teacher. Some student behaviors are related to the "lesson" and others are more "social."

Chapter IV of this handbook describes a procedure whereby data from teachers and children may be collected in classrooms. The techniques of interaction analysis (including matrix analysis) will be applied to the collection and analysis of this data. The categories which will be applied to the classroom behaviors of teachers and pupils have been developed specifically for the Science Curriculum Assessment System and will be referred to as "SCAS Classroom Interaction Categories." The specific techniques for application of these categories have also been developed specifically for SCAS. These are subsequently referred to as "SCAS classroom observational techniques."

III. SCAS Individual Interviews: Techniques and Task Protocols

General Procedures

Certain important techniques and procedures are applicable to all task protocols: this section will be devoted to discussion of these techniques.

It is difficult for the newly trained interviewer to refrain from talking too much. The temptation to lead or praise the child must be resisted. Statements such as "that's right" or "fine" or "O.K." should not be made when the child has responded to a question. These statements tend to reenforce the child no matter which answer he has given.

The interviewer may well ask "Well, what do I say when a child has responded to a question?" This is indeed a justifiable inquiry since the interviewer certainly cannot sit and stare dumbly at the child with no response. The child usually expects and sometimes waits for some form of response from the interviewer. The accepted procedure is for the interviewer to parrot back the child's response by saying, "You think (child's answer)?" This procedure allows the interviewer to verbally interact with the child and yet by merely repeating the child's response the interviewer has not given anything away.

On the other hand, if the interviewer uses inflection in his voice then it may become obvious to the child whether he has given a correct or incorrect response. The interviewer must develop an evenly modulated tone of voice that gives no hint of surprise or satisfaction to the child. Children are extremely adept at reading the appropriateness of the reply by the way the interviewer responds.

For some strange reason many adults feel that they must be condescending or "talk down" to a child. Such adults use a ridiculous tone of voice and exaggerated inflections to communicate with the child. This type of behavior is absurd, and children resent such condescension to the extent that they are often repulsed by such behavior. The experienced interviewer will talk to the child in an even voice, in the same tone and manner that he uses in talking to another adult. There is no need to "gush" when talking to a child -- the interviewer will find much more cooperation if he refrains from this type of behavior.

Another "disease" that has been observed in beginning interviewers is that of the "Oh, they are so cute," malady. The experienced interviewer is pleasant and friendly but is not enamoured by the little girl's saucy curls or the little boy's crewcut. The interviewer must remain constantly alert for the half-uttered phrase that contains the key to the child's thoughts concerning a particular task. The interviewer must keep in mind

that SCAS is an evaluative system for measuring change in the way the child interprets his environment, and the goals of SCAS will not be realized if the interviewer becomes so enamoured with the mere presence of the child that he neglects his primary duty.

The above "don'ts" for giving tasks to children are highly important, but they pale in comparison to the worst interviewing fault of all--leading the child. The interviewer that leads the child is prone to be somewhat impatient, in that he cannot wait for the child to respond. This interviewer puts words into the child's mouth, or utters such statements as, "You see that these two are the same, don't you Tommy?"

The beginning interviewer should not be misled in thinking that "leading" the child is accomplished by verbal means alone. Many of the children will be watching the interviewer carefully to detect some slight facial expression or some action that will offer a clue to the "correct" response. The interviewer must be poised and aware of what he is doing at all times.

With such a list of things not to do, it is perhaps time to indicate a few things that the interviewer <u>may</u> do. Certainly the interviewer should be friendly and at ease with the child; laugh with the child at amusing incidents; chat with him about things other than the tasks while you are preparing for the next task; and above all, give the child confidence by your interest in what he is doing and saying about the tasks themselves.

Preparing to Give Interviews

The interviewer must have all equipment set up before the child enters the room. In addition, the recording equipment must be prepared. An interviewer cannot possibly write or memorize <u>all</u> of a child's responses in a thirty-minute interview -- there are too many exchanges. This use of small tape recorders allows a complete audio record of the interview.

The small tape recorder should be concealed from the child's view, and is best accomplished by placing the recorder in a briefcase which is left on the table. A small wire and on-off switch can be taped underneath the table so the interviewer can control the recorder.

The users of SCAS should understand the purpose of hidden recording equipment -- the only reason for concealing the tape recorder is to reduce the amount of pressure on the child. Think of it in this way: the child enters a room and faces an unknown person who asks him a lot of unusual questions about some objects that he has never seen before. The interview alone poses a threat to some children, therefore, it seems unnecessary to increase the pressure on the child by the obvious presence of a microphone and tape recorder. Some children become somewhat frightened when they observe a microphone and are aware that they are being recorded.

The only sounds that are on each tape are the interviewer's questions and the child's responses -- the child's name is not recorded. The code numbers for the tapes are recorded with the child's code number, therefore, no child can be identified by some person who does not have access to master subject lists.

When all equipment is in place and the tape recorder is ready, the interviewer should go to the classroom and obtain the first child. At this time the classroom teacher should say to the class, "Today, Mr. Jones is here to play some games with you."

Introducing the Child to the Task

Each interviewer undoubtedly will establish an introductory sequence or exchange with the child, and he should try to remove any fears that the child may have. The following protocol is suggested.

The interviewer should set the child at ease the moment he enters the room; the interviewer should be friendly, ask the child his name, and proceed to chat for a moment. A little time (a minute or two) should be used to establish a friendly rapport with the child. The child should be told that this is not a "test" and that these games have nothing to do with his school grades.

During this time the interviewer should record the child's name on the Interview Data Sheet and check to be sure that the other information on the sheet is filled in correctly, i.e., tape number, interviewer's name, date, child's identification number, etc.

After the above, the interviewer should say something similar to the following: "We are going to play some games today; I am going to show you some things like water, blocks, string, and pictures, and I am going to ask you some questions about them. There aren't any tricks in any of these, I just want you to tell me what you think about these things."

After this initial introductory speech the interviewer should begin with the first task.

Speed of Task Presentation

One word should be included as to the speed with which the interviewer goes through the tasks. In the present version of SCAS there are twelve tasks that must be administered to each child. These tasks must be administered in less than forty-five minutes, so, needless to say, the interviewer does not have time to chat very long with the child or let the child go over and over a particular task. The interviewer must draw the fine line between pressing ahead with each task and not rushing the child. Experience is the best teacher.

Equivalence Relationship

Many of the tasks used in SCAS are based upon some equivalence relationship. Certain tasks require that the child establish an equality between two objects. This equivalence must be established firmly in the child's mind. If the equivalence is not established, then the task is of no value.

It does little good for the interviewer to establish equivalence for the child -- the interviewer might do this by "leading" the child. At times the interviewer will work with the child to help him see an equivalence relationship, but at no times should the interviewer force an equivalence relationship upon the child.

During the course of any task, if it should become evident that an equivalence relationship was not firmly established in the child's mind then the interviewer should return to the original protocol at the point of establishing equivalence.

If equivalence can be firmly established on the second trial, the interviewer should go ahead with the task. If the equivalence relationship is not firmly established in the child's mind, the task should be terminated at this point and the interviewer should proceed to the next task.

Order of Task Presentation

There are twelve tasks to present to the children. The order of presentation is of little consequence and should be varied from child to child. The interviewer must make sure, however, that he presents all twelve tasks to each child. Some method of placing the equipment on the table may help the interviewer keep track of what task he has given and what task he has not given.

Each interviewer should vary his order of task presentation so that he does not ever give the tasks in the same order.

SCAS Interview Protocols

TASK 1 (Conservation of Continous Substance)

(NOTE: This task should be performed on paper towels on top of the felt table covering. The clay will stain the cloth.)

Experimenter (E) presents 4 balls of clay to the subject (S). E should say, "Two of these balls have the same amount of clay in them. Can you pick which two?"

If S selects incorrectly, E should say, "Are you sure those two have the same amount of clay?" E should make two or three attempts in guiding S to select the correct balls of clay, but at no time should E force his own opinion or decision upon S. If S cannot select the equivalent balls of clay, E should proceed to the next task.

If S selects the two equivalent balls of clay, E should remove the non-selected clay balls from the table and say, "You keep one of the balls and give me one of the balls." (E should indicate that S place his ball of clay in front of him on the table and that S should place E's ball of clay in front of E.)

Then E asks, "Do we have the same amount of clay?" If S is doubtful E should again attempt to establish equivalence between the two balls of clay. If S thinks there is an unequal amount of clay in the two balls E shculd say, "Would you like to take a small piece of clay from one of the balls and put it on the other?"

E should proceed with the line of questioning until either S transfers some clay and is satisfied as to the equivalence of the two balls or, it becomes obvious that S cannot establish and maintain equivalence in his own mind. If S can establish the equivalence, the task may proceed.

E then proceeds to roll his ball into a "sausage" or "hot dog" shape with a comment such as, "Watch what I do. I am going to roll my clay ball into a sausage." After this, E asks, "Do these two have the same amount of clay?" (E points to the ball and the sausage.)

TASK 2 (Conservation of Discontinuous Substance)

E shows S some small sinkers (all alike) and two small jars or containers. The two containers are identical.

E tells S, "We are going to play a game. Every time I put one of these (pointing to the sinkers) into my jar, I want you to put one in your jar." E then proceeds to pick up one object and place it in his jar. E allows S time to place an object in his jar.

The filling procedure is repeated until the two jars are about 2/3 full. E then places the two jars side by side and asks S, "Do these two jars have the same amount of sinkers?" Then, "Why do you think so?"

Next E presents a third (larger) container and says, "Pour the sinkers from one of the small jars into this jar." After S has completed transferring the sinkers from one of the small jars to the larger jar, E asks, "Do these two jars (pointing) have the same amount of sinkers?" After S responds E asks, "Why do you think so?"

Then E asks, "If we made a row of sinkers using all of these (pointing to large container) and another row of sinkers using all of these (pointing to small container), would the two rows be the same or different?"

If S answers "different" then E asks, "Which row would be longer?" After either response, E should ask, "Why do you think so?"

TASK 3 (Conservation of Number)

E shows S some red and black checkers, and says, "Watch what I do. I'm going to make a row of black checkers." E then proceeds to make a row of eight black checkers.

E says, "I would like for you to make a row of red checkers beside the row of black checkers, but I want you to make your row so that there is one red checker for each black checker."

E then hands S all the red checkers. After S has completed his row of red checkers S will have some extra red checkers, and he may admit that there are too many red checkers on the table. E may take the extra red checkers from S only if S agrees that there are too many red checkers.

If S cannot make the equivalence between the two rows, or does not admit to there being extra red checkers, then E should say something to the effect "Are there the same number of red and black checkers?" E should not force S into the establishment of equivalence, but should gently question as to the number of red and black checkers.

If S still does not admit to the equivalency of the two rows of checkers or cannot establish the equivalency of the two rows of checkers then the task should be terminated and E should go to the next task.

If S does establish the equivalence of the two rows of checkers then E should remove all excess checkers (those not in the two rows) from the field of view. Then E can proceed with the questions: "Are there the same number of red and black checkers?" then, "Why do you think so?"

Then E says, "Watch what I do. I am going to move the black checkers." E then proceeds to move the black checkers into a group and asks, "Are there more red checkers, more black checkers, or are there the same number of red and black checkers?" Then, after response, "Why do you think so?"

Then E says again, "Watch what I do. I am going to move the black checkers once more." E then proceeds to arrange the black checkers into a long row parallel to the red row. This row of checkers should be 1 1/2 to 2 times as long as the red row.

Then E asks, "Are there more red checkers, more black checkers, or the same number of red and black checkers?" Then, "Why do you think so?"

TASK 4 (Multiplicative Classification)

E shows S a cardboard with three drawings of dogs pasted to the cardboard. There is one "empty" place on the cardboard - room for another drawing.

E says, "Here is a board with three dog pictures on it. I want you to look at them carefully and decide what kind of dog picture should go in the other corner of the board."

E then procedes to show S six other dog pictures: "Look over these pictures carefully; pick the one that you think goes best on the board." After S has selected a picture and placed it on the board, E then says, "Why did you pick that one?"

E should then make one or two selections from the remaining four dog pictures, each time asking "Would this one be better than the one you picked or not?"

The purpose here is to find S's reasons for picking a particular dog picture and to investigate the strength of his conviction. After S has reached a final decision as to the dog picture he would like to place on the board, E should again question S as to why he thinks that particular picture should be selected.

When S has made his final choice, E must look on the back of that picture and say the number so the data will be on the tape. E might say "So you think number _____ is the best picture."

TASK 5 (Class Inclusion)

E shows S some toy animals and says, "Here I have some animals. Do you know what kind of animals?"

E should help S name the cows and horses, let S help place the animals on the table.

Then E asks, "Are there more cows or are there more animals?" Then E should ask "If we took all the cows away would we have any animals left?" Then, "If we took all the animals away would we have any cows left?"

TASK 6 (Ordering by Length)

The equipment is composed of fifteen ordered dowels. E gives S eight of the dowels, every other dowel, beginning with the shortest one.

Then E says, "I would like for you to place these sticks in order - start with the shortest one and put them in order until you get to the longest one." After S attempts to arrange the sticks in order E says, "Are the sticks in order?"

If S has not arranged the sticks in order then E should terminate the task. If S has arranged the sticks in order, E should select at random three sticks from the remaining seven and say, "We forgot about these. See if you can put them in their proper places." If S can insert these in their proper places, E says, "And here are some more. See if you can put them in their proper places."

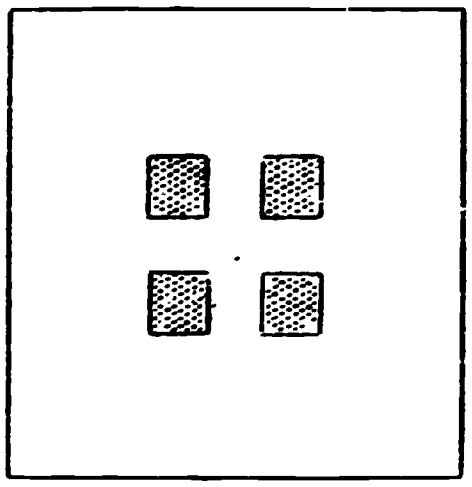
The problem here is getting the data on the audio tape. In order that the data may be correctly reported, the experimenters will adhere to the following procedure: If the child inserts the sticks correctly, the experimenter must say, "Oh, you have made a set of stairs."

If the experimenter does not make the above statement we will assume that the child did not insert the sticks correctly and did not build the correct series.

TASK 7 (Conservation of Area)

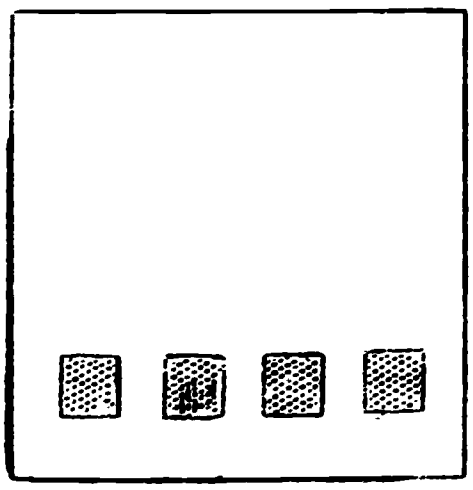
E shows S a piece of green felt and says, "Do you know what cows like to eat? Do they like to eat grass? We are going to pretend this is grass. Here are two cows, you put them on the grass."

Then E says, "Now we will pretend these are barns. Watch where I put the barns." E arranges the barns as shown in Figure 2A.



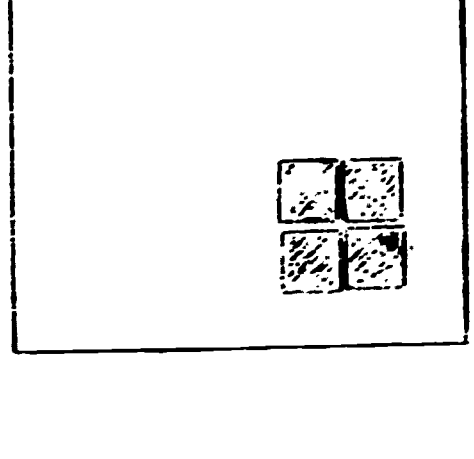
Then E says, "Look at all the grass the cows have to eat." After this, E says, "Now watch what I do. I'm going to move the barns."

E then proceeds to move the barns so they appear as shown in Figure 2B.



Then, "Do the cows have more grass to eat, the same amount of grass to eat, or less grass to eat?" After S's response, E asks, "Why do you think so?"

Then E says, "Watch again. I'm going to move the barns once more." E then arranges the barns as shown in Figure 2C and says, "Do the cows have more grass to eat, the same amount of grass to eat, or less grass to eat?" Then "Why do you think so?"



TASK 8 (Conservation of Weight)

E shows S four pieces of aluminum foil and says, "Two of these pieces of foil have the same weight. Can you pick the two that have the same weight?" Here S must establish equivalence between two of the pieces of aluminum foil.

E should work with S carefully to see whether or not S can establish the necessary equivalence. If S selects two pieces of foil that are not equivalent, then E may change his terminology to use the word "size," for example, "Are you sure these two are the same size?"

At times it is helpful to place the two pieces of foil one on top of the other so that S may see they are not the same size. When doing this E should make such statements as, "Are you sure these two are the same weight (or size)?"

Some children will not admit to the equivalence of the two equal pieces of foil. When this happens E should ask S, "Can you do anything to make the two pieces have equal weight?"

It is perfectly admissible for S to remove a small piece of foil from one of the two equivalent pieces so that in his own mind at least the two pieces do have equivalent weight.

If S cannot make or does not admit to equivalence between the two pieces of foil, the task should terminate at this point and E should begin the next task.

If S does admit to the equivalence of the two pieces of foil, E should remove the non-equivalent pieces of foil from the field of view and continue with the task.

E says, "Watch what I do. I am going to fold one of these pieces of foil." E then proceeds to fold one of the pieces of foil in half, then half again, and again, etc., until it cannot be folded further. The foil must be folded repeatedly so that it will sink in the cup of water.

Then E says, "Look at these two pieces of foil (pointing). Do they have the same weight?" Then, "Why do you think so?"

After S has responded, E shows S a cup of water and says, "Here I have a cup of water. I want you to put this piece of foil (indicating the folded piece) into the cup of water." After this, E says "What happened?" After S has admitted that the folded piece has sunk to the bottom of the cup, E says, "Watch what I do. I'm going to put the other piece of foil into the cup." Then again, "What happened?" After S has responded that this piece of foil floated E says, "Do the two pieces of foil have the same weight or not?" Then, "Why do you think so?"

TASK 9 (Conservation and Measurement of Length)

E shows S two pieces of string or cord and asks, "Are these two pieces of string the same length?" If S makes no move to compare the two pieces of string E may say, "Is there any way you can tell for sure?"

If S does not establish the equality of the two pieces of string, then the task should terminate at this point. If S does establish the equality of the two pieces of string then E should proceed with the task.

E then lays one piece of string on the table so that it is straight and places the other piece of string into a curved or crooked position. Then E asks, "Are the two pieces of string the same length?" And after this, "Why do you think so?"

After this E says, "Is there any way you can tell for sure? Can you measure the two pieces of string to find out?" If S replies that he could measure the piece of string, E says, "See if you can use one of these sticks to measure the strings." (E hands S one of the small dowels from the Ordering Task.) After this E again repeats the questions, "Are the two pieces of string the same length? Why do you think so?"

Again we face the problem of getting the necessary information on the audio tape. If this child does not establish equivalence between the two strings, the person transcribing the audio tape will be aware that the task terminated and have no difficulty in scoring. However, if the task proceeds beyond this point there may be difficulty in ascertaining just how S behaved during the remainder of the task. For clarity's sake the experimenter should make statements which will allow interpretation by the person listening to the audio tape. For example, such statements as, "Oh, you're putting the two strings side by side." Or, "You're sliding the small stick along the straight string." Etc.

TASK 10 (Conservation of Perimeter)

E should place the loop of small metal chain on the table so that it lies in the shape of a square. E should say, "Here I have a small metal chain; I'm going to put it on the table like this. Now let's pretend there is an ant here (pointing to a place on the chain). We will pretend that the ant is going to walk all the way around the chain."

E then proceeds to move his finger slowly around the entire loop back to the starting point. Then E says, "Watch what I do now." E proceeds to make one long narrow loop of the chain and says, "Pretend the ant is going to walk around the loop of chain again." E proceeds to run his finger all the way around the elongated loop of chain and says, "Does the ant have to walk more, the same amount, or less than he did before?" Then, "Why do you think so?"

TASK 11 (Conservation of Displacement Volume)

E shows S a plastic box containing some water and a stack of cubes resting on the bottom of the box. E also has an identical set of cubes outside the box.

E says, "Here we have a plastic box with some blocks sitting on the bottom. The box also has some water in it. Do you know what I mean if I say the 'water level' on this box?"

If the child does not know the meaning of the water level then E says, "Do you know what I mean if I said the top of the water?" "Can you point to the top of the water?" E should allow S time to respond and then help him find what is meant by water level or top of the water.

Finally, S must point to the water level line on the outside of the plastic box. If S cannot point to the water level or is not perfectly clear what you mean by the term water level or top of the water then the task should terminate at this point.

If S can point to the water level or top of the water then E should proceed with the task by saying, "Here (pointing to the blocks on the table) we have a set of blocks just like the ones that are in the box. Would you like to see one?"

E hands S one of the blocks for examination and then returns the block to the stack. "Let's pretend that we took all of the blocks out of the box. What do you think would happen to the top of the water, or water level? Would it go higher than it is now? Would it stay the same as it is now, or would it go lower than it is now?

E should lift the duplicate set of blocks on the table so that S understands what E is talking about when he says lift the blocks out of the box. After S has responded, he should be asked, "Why do you think so?"

E proceeds by saying "Let's pretend that we use this wire (holding wire in hand) and put it down in the box (E sticks wire into water) and knock the blocks down so they all rest on the bottom of the box. We can do that with the blocks out here, so you can see what I mean."

E then proceeds to use the wire and knock the duplicate set of blocks down on the table and says, "Remember, we are thinking about knocking the blocks down, the blocks that are in the box." (E should again put the wire back in the water.)

A crucial part of this task is in being certain that S understands E means the blocks in the box. Since E does not actually perform the operation of knocking the blocks down, it must be clear to S that E is asking him about the blocks in the box of water and that E is using the duplicate set of blocks on the table to demonstrate how the blocks would look if they were knocked down.

Then E should ask "Now if those blocks in the box were knocked down, what do you think about the top of the water, or water level? Would it be higher than it is now, would it be lower than it is now, or would it be the same as it is now?" (E should point to the various water level positions as he names them.) Then E should say, "Why do you think so?"

TASK 12 (Perspective)

The mountain board should be placed at least six feet in front of S and slightly below his eye level when he is seated. E should be certain that S can see the mountains clearly, and that there is plenty of light so that S has no difficulty is perceiving the arrangement.

E says, "Look at the little mountains over there (pointing)." E should get up, walk over to the mountains, and point to the various mountains as he says, "Here there is a tall mountain with snow on top, here there is a smaller mountain with a tree on top, and here there is a little mountain with a house on top."

E then returns to his seat and says, "I want you to look at the mountain carefully. I am going to show you some pictures of the mountains and I want you to pick one of these pictures. All of the pictures are of these little mountains, so you should pick the one that looks like the mountains look from where you are sitting now."

E then shows S the folder marked "Front View." When S indicates the picture he has chosen, E should say "You think it looks like picture _____." (E must get this sentence on the audio tape since this is the only way we have to record that data.)

E then takes the "Front View" folder from the child and says, "Now I want you to pretend that you're sitting behind the mountains." E should rise and either stand behind the mountains or indicate with his hand where S should pretend he is sitting.

E hands S the "Back View" folder and says, "From this folder I want you to pick the picture that looks like the mountains would look if you were sitting behind the mountains." When S has selected the picture E should again say, "You think it would look like picture number _____."

E should take the "Back View" folder from the child and say, "Now pretend you are sitting on this side of the mountains." E should rise and indicate the left side (child's left) of the mountains by standing or indicating with his hand the position he means.

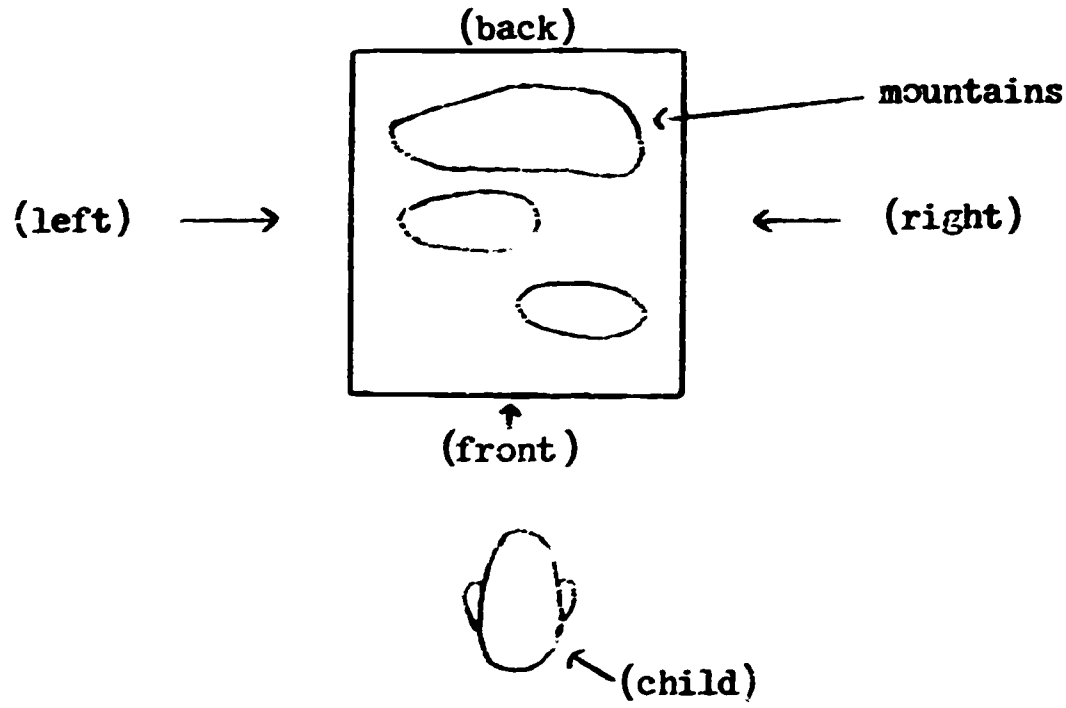
E hands S "Left View" folder and says, "Pretend you are sitting over there looking at that side of the mountains. From this folder I want you to pick the picture that shows how the mountains would look if you were sitting over there."

The same procedure is followed for the final "Right View" folder. Each time, E must report the picture number so it can be recorded.

E should not use the terminology left and right in this task, and there is no need to ask the child "Why do you think so in this task?"

If the child cannot match the front view picture with the front view of the mountains then the task should terminate at this point and no other view should be pursued. If the child <u>does</u> match the front view then all four views should be presented to the child.

The drawing below shows the approximate arrangement of the mountain board and the positions of left and right.



It is imperative that all interviewers proceed in the same order on this task. E should present the front view, back view, left view (child's left), and right view (child's right), to the child <u>in that order</u>. If this order is not followed then there will be nc way to interpret data from this task.

Procedure Following an Interview

After all tasks have been given, E should say something similar to, "Well, that's all the games we have to play. Thank you very much for your help. Would you ask your teacher to send (child's name) to play the games with me?"

When S has left the room, E must do several things in preparation for the next child. First, and most important, the tape recorder must be prepared for the next interview, second, the Interview Data Sheet must be prepared; third, certain equipment must be made ready. The clay "sausage" must be made into a ball; foil must be removed from the cup of water; and the sets of dowels must be separated.

For each interview session (Day) the interviewer will use one Interview Data Sheet (see sample - next page). The upper portion of the sheet must be completed carefully, then one of the data sections must be filled in for each child interviewed. (If the child does not know his birthdate, the interviewer must obtain the information from the classroom teacher.)

INTERVIEW DATA SHEET

Grade Level _______ School ______________________________

Classroom Teacher ______________________ Series No. ____ Day No.____

Student's full name ______________________________

Student's code no. R/B 1 2 3 4 5 6 Sex M F

Birthdate _____ _____ _____ (month day year) Age _____

Cassette No. and Side _______ A/B _______

Student's full name ______________________________

Student's code no. R/B 1 2 3 4 5 6 Sex M F

Birthdate _____ _____ _____ (month day year) Age _____

Cassette No. and Side _______ A/B _______

Student's full name ______________________________

Student's code no. R/B 1 2 3 4 5 6 Sex M F

Birthdate _____ _____ _____ (month day year) Age _____

Cassette No. and Side _______ A/B _______

Student's full name ______________________________

Student's code no. R/B 1 2 3 4 5 6 Sex M F

Birthdate _____ _____ _____ (month day year) Age _____

Cassette No. and Side _______ A/B _______

Student's full name ______________________________

Student's code no. R/B 1 2 3 4 5 6 Sex M F

Birthdate _____ _____ _____ (month day year) Age _____

Cassette No. and Side _______ A/B _______

IV. Classroom Observations of Teachers and Children

The person who has attempted to objectively and systematically describe the classroom behaviors exhibited by teachers has found this to be an extremely complex and difficult task. He has found that teacher behaviors are extremely variable and that unbiased descriptions are hard to come by. It is necessary that SCAS include not only these highly variable classroom teacher behaviors but the equally difficult to obtain and describe pupil behaviors. SCAS classroom observational techniques have been designed to minimize the difficulties associated with unbiased observation and reporting of teacher and pupil behaviors. These observational techniques require a systematic recording of spontaneous activities and behaviors on the parts of teachers and pupils. Each small bit of behavior must be recorded immediately following its exhibition or, in some instances, during the exhibition of this behavior. The purpose of classroom observations associated with the Science Curriculum Assessment System is to objectively and systematically collect data on selected aspects of teacher and pupil classroom behaviors. These data make possible the assessment of changes in behaviors which are associated with the implementation of elementary school science programs. These observational techniques are also useful in providing curriculum developers with systematic and objective feedback on the classroom implementations of their curriculum materials.

A. Description of SCAS Classroom Interaction Categories

SCAS Classroom Interaction Categories require classification of classroom behaviors into two major groups: teacher behaviors and student behaviors. Since teacher behaviors and student behaviors are not independent, the application of the SCAS observational techniques preserves the interrelatedness of teacher behaviors and student behaviors.

Page 35 shows that classroom behaviors fall into the groups: "student behaviors" and "teacher behaviors." Student behaviors are grouped into: (1) those behaviors which are related to the lesson (L) and (2) those student behaviors which are not related to the lesson (N). Page 35 also indicates that teacher behaviors are grouped into: (1) teacher behaviors which involve teacher interactions with less than seven children (S) or (2) teacher interactions with more than six children (T).

Within the two sub-categories of student behaviors, the SCAS Classroom Interaction Categories include ten behaviors (p. 36). The SCAS Classroom Interaction Categories for teacher behaviors also breaks each sub-group into ten specific teacher behaviors (p. 37).

Notice that one of the ten categories in each sub-group of teacher behaviors and student behaviors is reserved for non-codable or non-classifiable behaviors.

There are a total of twenty student behaviors that may be coded on the SCAS Classroom Interaction Categories for Students. Page 37 indicates that there are also twenty teacher behaviors which may be coded on SCAS Classroom Interaction Categories for Teachers. However, the SCAS Observational Techniques explode teacher categories into a total of four hundred teacher behaviors. This is done by combining the teacher behaviors shown on page 37 with the student behavior with which it is associated. Therefore, by a relatively simple coding system, it is possible to code four hundred twenty different classroom behaviors on essentially twenty different coded behaviors.

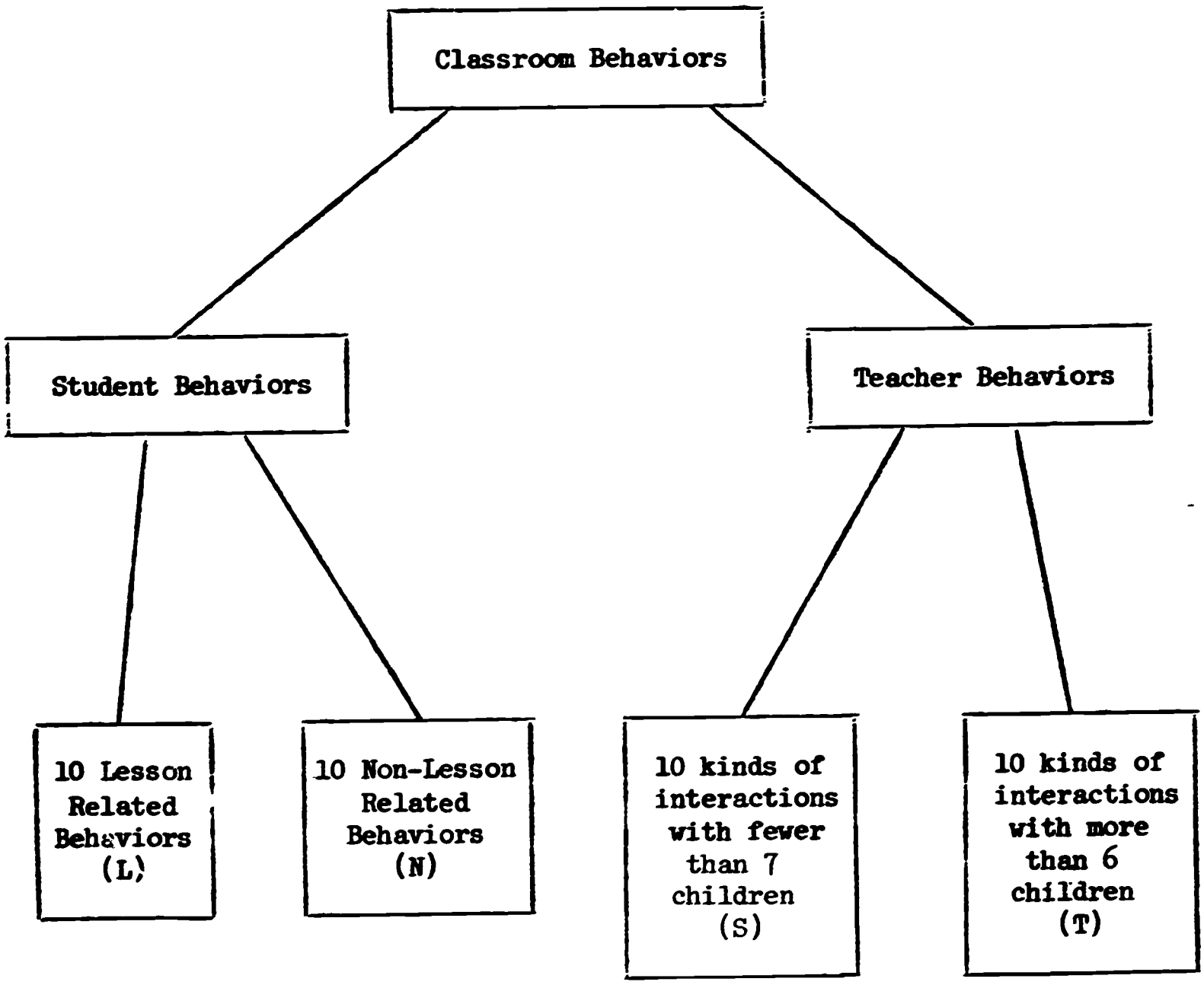
SCAS Classroom Interaction Categories - Student Behaviors

Page 36 gives an outline of SCAS Classroom Interaction Categories for Student Behaviors. On this set of categories, any classroom student behavior can be identified by a two-place code. The observer of student behaviors must make two decisions in order to code an interval of student behaviors. He must decide:

1. Is the student behavior "lesson related" (L) or "non-lesson related" (N)? "No decision" is coded by "0".

2. Within the sub-group, what is the student behavior (1-9)? "0" again means "no decision".

SCAS Classification of Classroom Behaviors



SCAS Classroom Interaction Categories - Student Behaviors

6/68

Lesson Related (L)		Non-Lesson Related (N)
L0	miscellaneous	N0
L1	observes teacher or student who demonstrates for teacher	N1
L2	follows teacher's directions (or suggestions) as to how the activity should be done	N2
L3	does not follow any specific teacher direction regarding how an activity should be done	N3
L4	responds to teacher question or request (by telling or showing)	N4
L5	initiates (or attempts to initiate) interaction with teacher; continues self-initiated interaction with teacher	N5
L6	initiates interaction with another student	N6
L7	receives ideas from another student (who is not demonstrating for teacher)	N7
L8	copies other student (or follows instructions of other student); must be preceded by "7"	N8
L9	gives ideas to another student (not at the request of teacher)	N9

SCAS Classroom Interaction Categories - Teacher Behaviors

6/68

Interacts with Sub-group - less than 7 children (S)		Interacts with total group - more than 6 children (T)
S0	miscellaneous	T0
S1	does not observe student behavior	T1
S2	observes student behavior but does not respond	T2
S3	accepts and/or encourages student behavior	T3
S4	suggests alternative to student behavior	T4
S5	rejects and/or discourages student behavior	T5
S6	reprimands student for behavior; "unpleasant" criticism; ridicule; sarcasm	T6
S7	asks questions (not rhetorical)	T7
S8	gives information to students; tells what activity should be done; asks rhetorical question	T8
S9	gives directions or information which tells how an activity should be done (more restrictive than "8")	T9

L-N Distinctions

"Lesson related" behaviors include those student behaviors which are associated with what the observer perceives as the science lesson. "Lesson related" student behaviors include reading books or looking at pictures, viewing television, examining objects, moving objects from one place to another. Almost any behavior may be considered "lesson related" if it facilitates the child's participation in the lesson.

Student behaviors which are "non-lesson related" include all behaviors which do not facilitate the student's participation in activities associated with the lesson. This includes reading a book which is not related to the lesson, observing a behavior of a fellow student, staring out the window, falling asleep, etc. If a student stands to look out a classroom window because he has heard a noise, this act of standing and looking out the window is a "non-lesson related" behavior. However, if the student stands to look out a window during the lesson that has to do with characteristics of trees on the playground, the observer must decide if the student is observing trees on the playground. If so, then this behavior falls into "lesson related" behaviors.

Perhaps some examples of "lesson related" versus "non-lesson related" behaviors are in order. Suppose the science lesson involves shadows and children are coming to the front of the room to make shadows on a screen. At the teacher's suggestion all children come forward in order to see shadows which are being made by one or two children. A student who stands and moves forward in the classroom and then observes the screen where the shadows are being made is exhibiting a "lesson related" behavior; his act of standing and walking forward in the classroom facilitates his participation in the lesson. However, a student who during this activity stands and walks around the room touching objects, jumping, sitting on a table, etc., is engaging in "non-lesson related" behavior. The initial behaviors of these two children are quite similar; they both stood and walked, but their behaviors are coded differently; one coded "L" and the other "N".

Imagine a classroom "session" which involves children selecting objects which are arranged on their table. One part of the lesson involves selecting objects with the eyes closed. Students are to pick up a circle without opening their eyes. The student who closes his eyes during this activity is engaging in "L" behavior. However, during a lesson that involves identifying color of an object which is held up by the teacher, the child who dozes with eyes closed is engaging in "N" behavior. The act of closing one's eyes might (during the same lesson) fall at one time into "lesson related" behaviors and at another time into "non-lesson related" behavior.

It should be apparent that in order to classify student behaviors, it is necessary that the observer be aware of the nature of the lesson and the role of student activities in the lesson.

Category 1. This includes children watching or listening to teachers. It might also include the behavior of watching or listening to another student if that student is assisting the teacher or demonstrating for the teacher. Teachers frequently devote a great deal of classroom time to talking to children. Children who are listening to the teacher are exhibiting "Category 1" behaviors. In this case, the distinction between "lesson related" behavior and "non-lesson related" behavior depends upon what the teacher is doing. If the teacher is talking about whether the child had breakfast or not during a lesson that has to do with classifying shells, the child who listens is exhibiting "N1" behavior. However, if the teacher is talking about different properties of shells, showing how shells might be classified, or suggesting that children remove shells from a box in the classroom, the child who is listening to the teacher is exhibiting "L1" behavior. If the teacher asks one child to come forward and pick up two shells that are alike, the child who watches this student is exhibiting "L1" behavior.

Category 2. This category includes behaviors associated with doing what the teacher has suggested (or told the child to do) in the manner in which the teacher indicated that it should be done. This requires that the teacher have given some information which limits the child's activity; telling him how the activity should be done. For example, the teacher has given the children some objects to be classified and has called the child's attention to the observation that some of the objects are red and some are blue. The child who classifies these objects into two groups (red objects in one and blue objects in another) is exhibiting an "L2" behavior. If the teacher has requested that all bus students raise their hands, the child who raises his hand is exhibiting an "N2" behavior.

Category 3. The child who exhibits behaviors which fall into Category 3 is not following any specific directions of the teacher regarding how an activity should be done. The child might be following teacher instructions regarding which activity to do, but he is following his own ideas regarding how the activity should be accomplished. The teacher who suggests that the child place objects in groups has given the child some information regarding the lesson but has not given the child specific directions as to how the objects should be grouped. The child who places a set of objects into groups by color and then classifies the same objects by shape has exhibited "L3" behaviors. The child who removes these objects from their container, rolls them into small "wads", and throws them out the window is probably exhibiting N3 behaviors (if we assume that the teacher did not direct the child to participate in the activity in this way).

Category 4. These include both verbal and non-verbal responses to teacher questions or requests. If the teacher asks a question which is related to the lesson and the child responds by verbally giving her information or by showing her something which he has done, his behaviors in both instances is L4. The child who responds to a teacher question which is not related to the lesson is exhibiting an N4 behavior.

Category 5. This category includes the initiation of any kind of interaction with the teacher, any attempt to initiate interaction with the teacher, and also the continuation of self-initiated interaction with the teacher. The child who raises his hand in an effort to gain the teacher's attention will be exhibiting either "L5" or "N5" behavior - depending upon the kind of interaction which he is attempting to initiate. If this child interacts verbally with the teacher his behavior continues in Category 5 for as long as he is telling or showing the teacher. If the child subsequently listens to the teacher or observes the teacher, his behavior falls into Category 1. Thus, "interaction" in Category 5 does not include observation (listening or watching).

Category 6. This includes verbal or non-verbal initiation of interaction with any student. The student who asks a fellow student a question about a lesson related activity or gives a fellow student information regarding a lesson related activity might be exhibiting in both instances "L6" behaviors. The student who pulls a girl's pigtail or pushes his neighbor is probably exhibiting N6 behaviors. This is also the case if he talks with a fellow student about non-lesson related topics.

Category 7. Receiving ideas or information from another student falls into this category. This does not include listening to or observing another student who is acting as the teacher's assistant or is performing a demonstration for the teacher. The student who receives ideas from another student may or may not have initiated the interaction. He may or may not give overt indications of using the ideas or information. If he hears the idea or information or is shown something which the other student has done, then his behavior falls into Category 7. The "L" versus "N" decision depends, of course, on the kind of information or ideas which he is receiving and on the lesson for the day.

Category 8. A Category 8 behavior must be preceded by a Category 7 behavior. The student who copies what he observed another student doing or who follows the instructions of another student is exhibiting Category 8 behavior. (The student who copies the behavior or follows the instructions of a student who is acting as a demonstrator for the teacher is exhibiting Category 2 behaviors.)

Category 9. These behaviors are the "reverse" of Category 7 behaviors. The student who voluntarily (or at the request of a fellow student) gives information to another student is exhibiting Category 9 behaviors. Obviously, if that information or idea is related to the lesson, then the behavior falls into "L9". (The student who gives ideas to another student at the request of the teacher is exhibiting Category 2 behavior.) The first-grade child who says, "Oh, let's put the squares and the circles together," is probably exhibiting Category 9 behavior. If the lesson involves classification, then her behavior is L9. The sixth-grader who suggests to her neighbor that they stop at the record store on the way home is exhibiting N9 behavior (probably immediately following N6 behavior). Category 9 behavior is frequently preceded by Category 6 behavior.

Category 0. Any behaviors which the observer cannot place in the above categories fall into the "0" category. If the child under observation leaves the room or is obscured from the observer's view, Category 0 is employed. This category will also be used if the observer cannot determine if the behavior is lesson related or non-lesson related.

SCAS Classroom Interaction Categories - Teacher Behaviors

On page 37 is an outline of SCAS Classroom Interaction Categories for Teacher Behaviors. Note that teacher behaviors fall into two major categories: (1) interaction with less than seven children and (2) interaction with more than six children. It should be noted that the teacher behavior falls into the "more than six children" category even if the teacher is talking with only one child if she is using that child as an assistant or as a demonstrator for more than six children. The effect of the interaction should be considered in making the decision between "less than seven children" and "more than six children" category. If the teacher's spoken word is heard by more than six children, the latter category is selected.

Category 1. These behaviors include those behaviors for which there is evidence that the teacher neither visually observes the student nor listens to his verbal behavior. The behaviors which fall into Category 1 obviously involve neither interaction with a small group of children or with a large group of children. Therefore, the decision with regard to "S" or "T" behavior is determined by the previously categorized behavior. If the teacher has been interacting with less than seven children, then Category 1 behavior is recorded as S1. If the teacher has been interacting with more than six children, then her Category 1 behavior is recorded as T1.

Category 2. These behaviors include those in which the teacher appears to watch and/or listen to the student but for which there is no indication of verbal or non-verbal response to the student.

Category 3. These behaviors include any indication on the part of the teacher that he accepts and/or encourages any student behavior. Acceptance includes nodding, saying "okay" or "yes," repeating the student's statement, etc. A smile in response to a student behavior is an indication of acceptance or encouragement.

Category 4. Suggestions of alternatives for student behaviors fall into this category. These behaviors might follow acceptance or rejection of student behaviors. The teacher who says, "That's very good, but can you think of another way of doing it?" has exhibited in quick succession Category 3 and Category 4 behaviors. Of course, if she exhibited these behaviors for a group of less than seven children (or an individual child) the behavior would be recorded as S3 followed by S4.

Category 5. Rejection or discouraging a student's behavior is the "opposite" of Category 3 behaviors. The teacher who indicates that a child's response to a question is incorrect is rejecting and/or discouraging that student behavior. The teacher who shakes her head "no" is rejecting or discouraging a student behavior. Category 5 behaviors are frequently followed by Category 4 behaviors. The teacher who says, "No, Johnny, I think you can find a better way of doing that," is exhibiting Category 5 behavior followed quickly by Category 4 behavior. If she directs this comment to Johnny in such a way that it is not heard or does not influence the behavior of more than six children, then her behaviors would be recorded as S5 followed by S4.

Category 6. The very severe rejections and dramatic discouragements of student behaviors are reserved for Category 6. These behaviors include reprimands which include an element of unpleasantness for the child. Criticizing, ridiculing, and using sarcasm fall into Category 6. These behaviors are usually intended to immediately terminate some student behavior. The teacher who says very loudly, "I will not have you leaving your seats without permission," is probably exhibiting a T6 behavior. She intends for that behavior to cease immediately. The teacher who complains, "I hate to have to continue to remind you . . ." is exhibiting Category 6 behavior. Unpleasant justifications of teacher authority fall into Category 6.

Category 7. If the teacher asks questions which she expects to be answered by a student the behavior is coded by "7". This also includes a statement which is grammatically not a question but has the effect of a question. For example, the teacher statement which starts out, "Tell me what you know about . . ." falls into Category 7 even though the statement is not grammatically a question. If the request is for the purpose of finding out what the student knows or can do, then it is probably a Category 7 behavior rather than a Category 9 behavior.

Category 8. "Showing and telling" in a way which communicates information to students is a Category 8 behavior. This category also includes identification of activities that the teacher wishes to have the students do. If the teacher says, "Find out what you can about pendulums," but does not describe how it is to be done, the behavior falls into Category 8. This category also includes rhetorical questions.

Category 9. Information from the teacher which tells the students how an activity should be done meets the requirements of Category 9. This category includes behaviors which are more restrictive to student behaviors than are Category 8 teacher behaviors. Giving directions to students which severely limit their participation falls into Category 9. These behaviors are not necessarily in the form of directions to students but might be information which may be interpreted as directions by the student. For example, the teacher who identifies the properties of objects which will subsequently be classified is considered to be giving directions with regard to how children should classify the objects. Frequent difficulties in differentiating between Category 8 and Category 9 behaviors are encountered; a "ground rule" will facilitate these decisions.

Category 0. The "miscellaneous" category for teacher behaviors includes those which the observer cannot place in the above described nine categories. This might include verbal interaction which the observer cannot understand or it might include short intervals during which the teacher cannot be observed. An important caution relates to Category 1. If the teacher leaves the classroom, this behavior goes into Category 1 even though the observer is not observing the teacher.

B. SCAS Observational Techniques --

Student Behaviors

In addition to becoming thoroughly familiar with the SCAS Classroom Interaction Categories for students, it is necessary that the observer establish certain specific classroom conditions prior to the observations. Since the observer will be focusing his attention on one single student during any given interval of time, it is necessary that the observer be able to identify children readily in the classroom. Since children will be moving from one place to another in the classroom, it is necessary that the observer be free to move in order to continue the observation of the child.

Although there are many who feel that a "roving observer" is quite distracting to teachers and students, it has been the experience of SCAS authors that both teachers and students very quickly become accustomed to the presence of "roving observers." Obviously, it is not possible to determine the extent of influence of the roving observer on classroom behaviors; he cannot observe if he is not there.

Prior arrangements with the classroom teacher should have been made so that each child will have randomly been assigned a color code for identification purposes and a number. Six children should be assigned to each color designation. The children within each single color identification should be assigned numbers 1-6 and should wear colored and numbered identification markers which are easily observed by the observer. Each observer should be prepared to observe six children and these six children should be identified by the same color code. This means that an observer would plan to observe, for example, six children who are identified by red 1, red 2, red 3, red 4, red 5, and red 6.

Prior to the arrival of the observer, the classroom teacher should have informed students that they will have observers and that these observers will not be expected to talk with the students or with the teacher. Observers should follow the practice of refraining from any kind of interaction (verbal or non-verbal) with children or teachers during the observation. If possible, the observer should have little or no contact with the children or teacher outside the classroom.

The observer of student behaviors should have identified (prior to his arrival in the classroom) the sequence in which the children will be observed. This decision should have been randomly made. The sequence in which the children will be observed should be written for quick reference by the observer during the observation.

Prior to the beginning of the observation the observer should be positioned (probably standing) so that he can easily begin to observe the student that will be observed initially in the teaching session. The coding form should have been completed to indicate the identification of the child, the teacher, and any other desired information. Coding sheets should be fastened on a "handboard" so that writing will be possible as the observer moves around the room during the observation. (A sample of a coding form for student behaviors is shown on pages 46 and 47.)

The observer should begin the observation as soon as there is any indication that the science lesson is beginning. If several observers are in the classroom, they should begin the observation at the same time by a pre-arranged signal. The observer categorizes, based on his interpretation of the effect of behaviors exhibited. For example, if the teacher has made statements which the child seems to interpret as directions which he follows, then the child's behavior would have been coded in Category 2 even though there may be some indication that the teacher did not intend to give directions to the child with regard as to how he should do the activity.

The observer starts categorizing by recording $\frac{0}{0}$ in the first position of the first line on the coding form. He will continue categorizing until a second pre-arranged signal is given. This signal should be given by a designated observer who responds to some indication that the science lesson has terminated.

Every three seconds the observer records a two-place code to identify the student behavior observed during the preceding three seconds. The two-place codes are recorded on the "Coding Form for Student Behaviors." If a shift in behavior occurs during the three-second interval, the observer will record the code for the previous behavior even though three seconds has not elapsed. The observer will, therefore, classify and record a behavior every three seconds (except when shifts occur in less than three seconds).

The student is observed for three minutes (or until a predetermined number of codes have been recorded). The observer then shifts his attention immediately to the second child to be observed and continues that observation for a three-minute interval or until the designated number of codes have been recorded. (The "coding form" is designed so that a page is completed every three minutes.)

Behaviors are coded by recording either "L," "N," or "0" in the first place position (top block) on the coding form. "L" is the symbol for lesson related behavior, "N" is the symbol for non-lesson related behavior, and "0" is the symbol to indicate that the lesson related behavior versus non-lesson related behavior decision could not be made. It is expected that the number of "0" should be few.

SCAS

CLASSROOM INTERACTION

CODING FORM

STUDENT BEHAVIORS

RED

School _____ _____
(name) (no.)

Teacher _____ _____
(name) (no.)

Date _____

Series _____

Day No. _____

Observer _____ _____
(name) (no.)

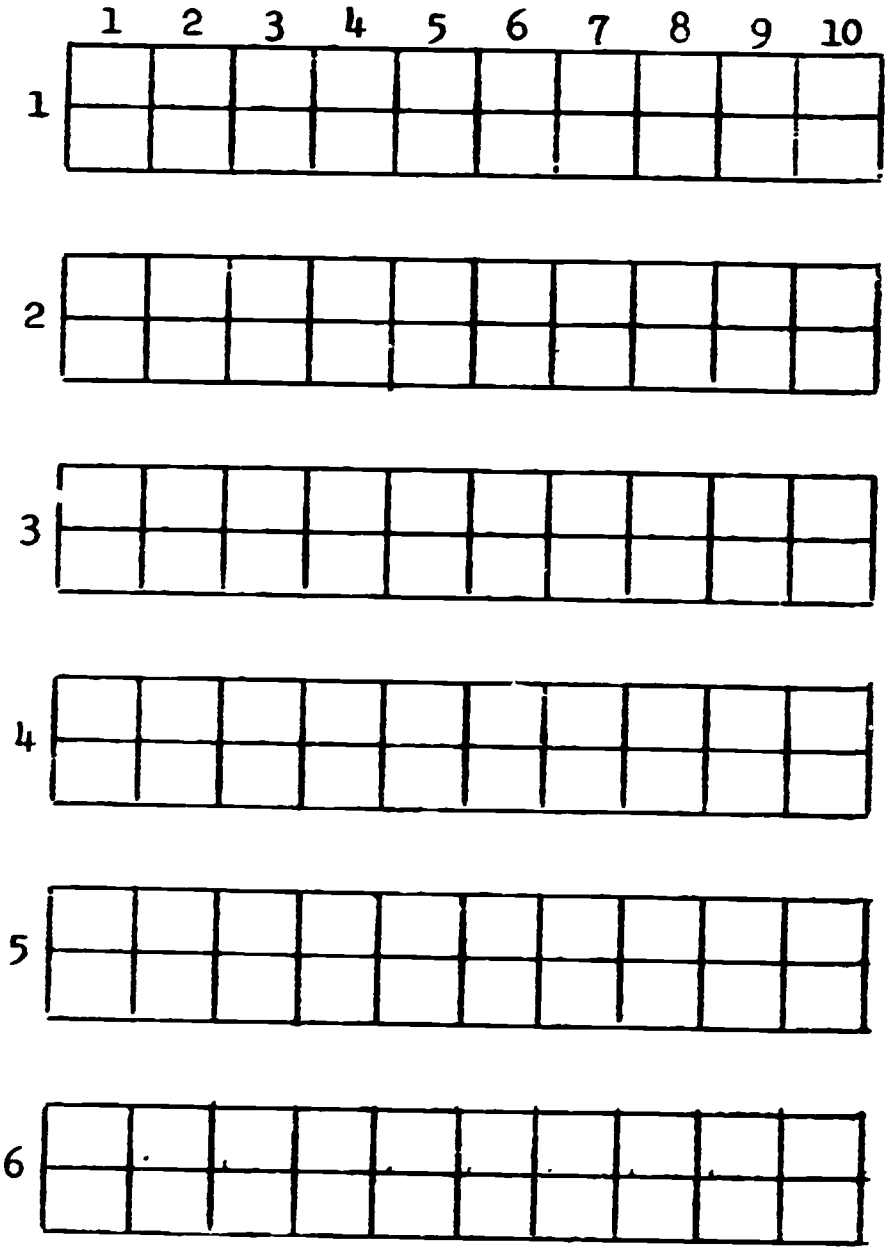
SCAS

CLASSROOM INTERACTION

CODING FORM - STUDENT BEHAVIORS

RED

STUDENT NO._____



The second place in the code for a three-second interval of behavior will be a number from 0 to 9 to indicate the specific behavior which the student exhibited during the preceding three seconds. Suppose an observer starts by observing Red-3 child. At the beginning of the observation the observer records [0/0]; at the end of the first three-second interval the observer has recorded [0/L]. This indicates that during the first three-second interval of the science lesson, the child listened to or watched (1) the teacher as he did something (verbal or non-verbal) which was associated with the lesson (L). At the end of the second three-second interval, the observer recorded [L/3] which indicates that the child has initiated (or attempted to initiate) some kind of interaction with the teacher. If the observer records during the third interval [4/2], this indicates that the child has now done something which the teacher told him to do (2) but which had no relationship to the lesson (N). The observer's coding form now looks like this:

PAGE NO. 1

SCAS

CLASSROOM INTERACTION

CODING FORM - STUDENT BEHAVIORS

RED

STUDENT NO. 3

	1	2	3	4	5	6	7	8	9	10
1	0	L	L	N						
	0	1	5	2			1			

This procedure is continued for the entire period of observation. If all six children are observed before the observation period terminates, then the observer repeats the cycle of observation -- observing each child for a three-minute interval (filling one "coding form" page for each child) before moving to the next child in the sequence. The last code on each page is [5].

The observer might wish to make notes in the space provided on the coding form describing any special observations which could not be coded, or any irregularities which may be associated with the observations or the classroom lesson which was observed.

Following the observation, the observer (if possible) leaves the classroom immediately to avoid any discussion with the teacher or the students on the data which was collected in the classroom. (If the

data collection is a part of a research investigation, it is quite likely that the classroom teacher should not have access to data until the research investigation is completed.)

The observer should immediately check all coding forms and cover sheets to make sure that all data has been recorded for accurate identification of classroom location, classroom teacher, and children observed. Page numbers should be checked so that the sequence of observation of children will be apparent for the analysis of the data. The coding forms associated with the observation of each classroom should be attached together for transportation to the data analyst.

C. SCAS Observational Techniques --

Teacher Behaviors

One of the unique aspects of the SCAS Observational Techniques is that a single observer does not simultaneously record both student behaviors and teacher behaviors. The observer who will code and record teacher behaviors must be familiar with both SCAS Classroom Interaction Categories for students and for teachers. The coding procedure will clarify the reason for this.

Prior to the initial observation in the classroom, the classroom teacher and the observer should be familiarized with the use of the broadcasting microphone which the teacher will wear during the observation and the equipment for receiving the signals from the broadcasting microphone. Tape recording the lesson is optional, but it is necessary that the observer of teacher behaviors be able to understand all verbal communications of the classroom teacher and those children who interact verbally with the teacher. It is therefore necessary that the observer wear headphones in order to hear whispers and quiet conversations between the classroom teacher, small groups of children or individual children.

The observer should be positioned so that he will be able to visually monitor the classroom teacher's behavior (and the behaviors of children who will interact with the teacher). It will probably be necessary for the observer to change his position during the observation.

The observer should have the SCAS Classroom Interaction Coding Form for Teacher Behaviors available and the cover page should be completed. An example of the cover page and a coding sheet is given on pages 51 and 52. The observer should also have numbered consecutively the pages of the coding form for teacher behaviors. These should be fastened on a "handboard" to facilitate writing by the observer while he moves about the classroom.

At a pre-arranged signal all observers begin coding simultaneously. The observer of teacher behaviors will record every three seconds a four-place code which describes not only the category from the SCAS Classroom Interaction Categories for Teacher Behaviors but also includes the related category from the SCAS Classroom Interaction Categories for Student Behaviors. At the termination of each three-second interval during the observation, the observer must make the following four decisions:

1. Is the teacher behavior exhibited during this interval associated with a student behavior which is lesson related (L) or non-lesson related (N)? "No decision" for this question results in recording "0".

2. Which student behavior is associated with the teacher behavior exhibited during this interval? This decision is recorded in the second place of the teacher four-place code. This decision is indicated by recording a number 0-9 taken from SCAS Classroom Interaction Categories for Student Behaviors.

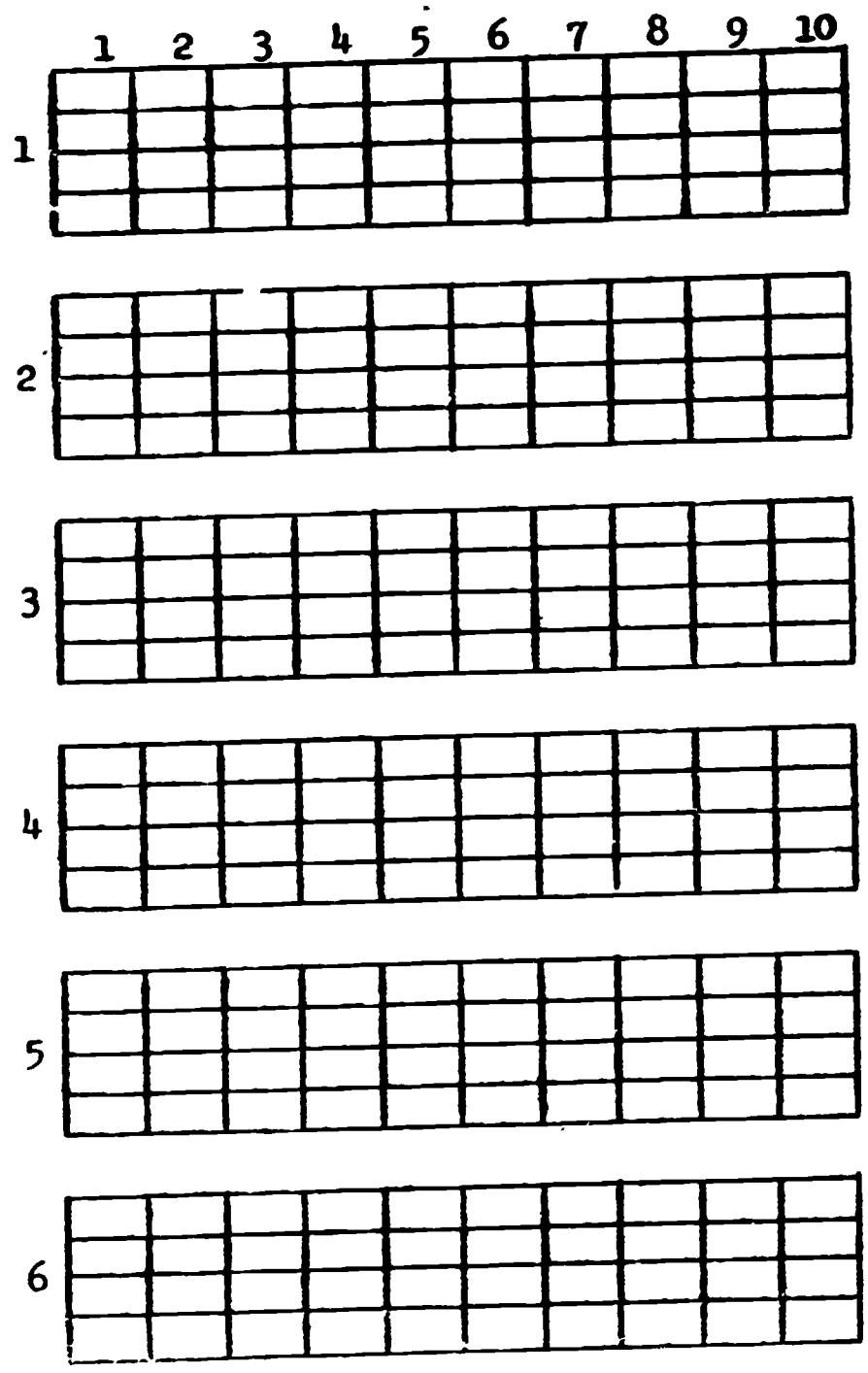
Page No._____

SCAS

CLASSROOM INTERACTION

CODING FORM

TEACHER BEHAVIORS



SCAS

CLASSROOM INTERACTION

CODING FORM

TEACHER BEHAVIORS

School _____ _____
(name) (no.)

Teacher _____ _____
(name) (no.)

Date _____

Series _____

Day No. _____

Observer _____ _____
(name) (no.)

3. Is the teacher interacting with less than 7 children (S) or more than 6 children (T)? This decision is recorded in the third place of the four-place code.

4. Which teacher behavior from the SCAS Classroom Interaction Categories for Teacher Behaviors is exhibited during the interval? A number 0-9 is recorded in the fourth place of the code in order to indicate this decision.

The observer of teacher behaviors must not only carefully observe specific teacher behaviors but must be aware of associated student behaviors in order to record a four-place code every three seconds. Practice in the use of the categories and techniques with video tapes or in live classroom teaching sessions make it possible for coding to become somewhat "automatic" particularly with regard to decisions 1 and 3 above. Clearly, it is necessary that the observer be extremely familiar with teacher behavior categories and student behavior categories in order to unhesitatingly make a decision, record that decision, and be prepared to observe during the next three-second interval.

The observer of teacher behaviors continues to code at the termination of every three-second interval after having recorded a | 0 | 0 | 0 | 0 | code in the first code position on the coding form.

Supose the following sequence of events is observed in the classroom:

1. The signal to begin observation is given while the teacher is removing envelopes from a box at the side of the classroom.
2. Teacher: "Is everyone back from the cafeteria now?"
3. Two students say "yes" simultaneously and two other students nod affirmatively.
4. Teacher: "Thank you very much -- then it's time to begin, isn't it?"
5. "Today we're going to do some activities like the ones we were doing yesterday."

The person who observes the events described above will have recorded after approximately 21 seconds the following coded behaviors on the coding form:

Page 1

SCAS

CLASSROOM INTERACTION

CODING FORM

TEACHER BEHAVIORS

	1	2	3	4	5	6	7	8	9	10
1	0	0	N	N	N	L				
	0	0	0	4	4	0				
	0	0	T	T	T	T				
	0	1	7	3	8	8				

6. The teacher now exhibits the first behavior which is associated with the lesson. 1 is coded

L
0
T
8

. Coding at three-second intervals continues.

When teacher behavior shifts from one category to another in less than a three-second interval, the observer codes the shift immediately and then goes back to the steady rhythm of coding every three seconds. The final code by the observer of teacher behaviors is always a four-place zero code

0
0
0
0

At a pre-arranged signal from one observer, the observation terminates and all observers leave the classroom immediately.

D. Ground Rules for SCAS Observational Techniques and SCAS Classroom Interaction Analysis Categories

Any attempt to apply somewhat arbitrarily identified categories to the bewildering complex of human behaviors is destined for frustration. With practice application of SCAS Classroom Interaction Categories can be accomplished with a fairly high degree of reliability.

Obviously, there are instances when the observer feels equally inclined to classify a behavior into several categories. He must select one. The following statements are intended to increase the extent to which different observers make the same decisions when faced with these frustrating problems. This list will continue to grow for as long as the author receives feedback from the application of SCAS Classroom Interaction Categories. The following ground rules cover the most commonly occurring difficulties encountered in the application of the categories

1. If there is a conflict in the application of ground rules, the rule occurring earlier in the list takes precedence.

2. If a child's behavior has been continuing in a specific category and his behavior seems to change but there is a controversy between the previous category and a new category, then the behavior should be coded in the category which has been continuing. In other words, there should be a specific reason for changing from one category to another -- particularly if the child's behavior has fallen into a single category for several intervals.

3. If there is any doubt between "L" and "N" categories the behavior should be coded "N."

4. If there is any doubt between "S" and "T" categories the behavior should be coded "T."

5. If there is any doubt among several categories the behavior should be placed in the category which is numbered highest. This also applies if several behaviors seem to be coded simultaneously.

6. If a behavior is coded and a subsequent bahavior indicates that the previous decision was inaccurate, then the previous code should be changed. For example if a child stands up and you think he might be standing in connection with the lesson (for example in order to see better) but the child then hops around the room swinging his arms and this has nothing to do with the lesson, then you would change what you had previously coded as L3 to N3. You would continue to code N3 until the child's behavior falls into a different category.

7. There will frequently be a question regarding behaviors falling into categories L1 and L3. Suppose a teacher is demonstrating in the front of the room and the child is listening and watching at his desk; he stands up in order to see better what the teacher is doing. While he's seated this is coded L1; during the intervals in which he stands the behavior is coded L3; coding goes back to L1 for as long as he stands without changing his position in order to see better or to participate in the activity. If he sits this behavior is coded L1 unless he is sitting for the specific purpose of facilitating his participation in the activity.

8. If it appears that verbal behavior and non-verbal behavior are incompatible, the behavior should be coded depending upon its <u>effect</u> on the teacher or student.

9. If a miscellaneous code is necessary, retain as much information as possible. This means that you should record a "0" only in the "place" where it is necessary. For example, if you cannot decide between "L" and "N" behaviors, this does <u>not</u> mean that you should record $\begin{array}{|c|}\hline 0 \\ \hline 0 \\ \hline \end{array}$ for the student behavior. You should, instead, record $\begin{array}{|c|}\hline 0 \\ \hline 2 \\ \hline \end{array}$ if the child is following the teacher's directions but you cannot decide if the directions are lesson related or non-lesson related.

10. The observer must avoid excessive concern with his own biases or with what he thinks is the teacher's intent. He must consistently make decisions based on the <u>effect</u> of the behavior on the teacher or the student. For example, if the teacher attempts to joke with a child regarding his behavior and it is obvious that the child perceives this as criticism or sarcasm, then the teacher's behavior is coded as "reprimand" (6). If a statement is grammatically a question but has the effect of restricting students' freedom considerably so that it becomes a specific teacher direction, then the teacher behavior is coded "gives directions" (9). Student behaviors associated with that "teacher direction" are coded "follows directions" (2).

11. If more than one behavior occurs during a three second interval, then all behaviors exhibited during that interval are recorded. Record each change in behavior. If no change occurs within three seconds, repeat the category number on your coding form at the next position to the right.

12. If the individual under observation becomes "unavailable" for observation, the appropriate code ("0" for student behavior or perhaps "does not observe" for teacher behavior) should be continued until there is a specific reason for change. In the case of observation of student behaviors, the "0" code should be continued until the child becomes "observable" or until the end of the designated time interval for observing that child. Then the observer should focus on the next child in the sequence. In the case of the teacher not being observable, the observer should continue the appropriate code (either miscellaneous or does not observe) until there is a specific reason for change.

V. Local Application of SCAS

A. Training for Observers and Interviewers

Training of Classroom Observers

It is necessary that persons who will apply SCAS Classroom Interaction Categories by utilizing the SCAS Classroom Interaction Techniques described in this handbook should participate in approximately forty hours of training prior to the collection of data which will be used for research purposes. Although there are many alternative ways to sequence the experiences associated with this training, the following sequence is suggested as one which is quite effective in producing trained observers who exhibit a high level of observer reliability.

a. The purposes and use of SCAS can be introduced in connection with the viewing of video tapes or films depicting varieties of classroom teaching behaviors and varieties of classroom student behaviors. If time permits, trainees should participate in developing procedures for recording classroom observational data. This emphasizes that SCAS is one way of doing this complex task.

b. Trainees must memorize codes for behaviors, starting with student behaviors. It is necessary that a number code be associated (without hesitation) with a category description. Number flash cards are useful for work by individual observer trainees or groups of trainees.

c. The next step in the training of classroom observers involves practice in the application of student behavioral categories. It is suggested that initial practice session utilize video-taped teaching sessions which are available from the authors of the Science Curriculum Assessment System. These tapes were prepared by simultaneously video-taping the teacher as she moved about the room and sampling individual student behaviors. The teacher tape includes the behaviors of the group of children with whom the teacher is interacting. A second tape simultaneously prepared includes individual children; each child was recorded for three-minute intervals. It is suggested that initial coding sessions should be simplified by first coding student behaviors into "lesson-related" or "non-lesson-related" categories. Then, viewing the same tapes, the observer fills in the second place of the code. Now he goes back with the same tape and attempts to fill in both first and second places of the code every three seconds. This should be done in small groups with a skilled SCAS observer as consultant. The tape should be stopped frequently to discuss variations in coding by the members of the group.

d. Memorize codes for teacher behaviors.

e. Coding teacher behaviors is considerably more complicated than coding student behaviors. Initially teacher behavior should be coded from video tapes which include teacher and the children which are interacting with the teacher. Teacher behaviors should be coded into "S" and "T" categories only. The observer should then re-play the tapes and code teacher behavior into the specific teacher behavior categories. When the observer is proficient in two-place coding of teacher behaviors, he should then add the place one ("lesson-related" versus "non-lesson-related") code. When he is proficient in coding first, third and fourth places, he should add the second place and continue practice coding until he is proficient in four-place coding.

It will be necessary in some instances to establish local ground rules which might apply to special situations that are not generally observed but which are of some importance in the local area.

Observer trainees are now ready to begin practice observations in "live" situations. Practice observations should continue until an "acceptable"level of inter-observer reliability is established.

Training of Interviewers

It is apparent from Chapter III of this handbook that the interview protocols must be memorized by the interviewers. One may well say that this is a mechanical operation and can be accomplished without help from an experienced SCAS interviewer. In effect, the interview protocols themselves are mechanical and can be memorized, but there is more involved here than just memorizing protocols.

Obtaining a child's choice in one of the tasks is a simple matter indeed, but obtaining, interpreting, and realizing the content of a child's reason for his choice is the difficult part of administering the tasks. The seemingly simple question, "Why do you think so?" contains the vital key to the way in which the child views his environment. If the tasks were scored on choices alone, then it might be possible to give children these tasks in classroom groups, but this would relegate the tasks to the same level as paper and pencil tests, and hence, the same criticisms. Therefore, it is of vital importance that the child's reasons and his interpretations of his reasons be obtained -- this can be done only by an experienced interviewer.

If an interviewer does not have an in-depth understanding of the tasks and the nature of the child's responses, then the tasks themselves are of no value.

The children's reasons for their choices on a task can be as varied as the number of children interviewed. The only possible way that an interviewer can gain understanding as to what the child is saying and what the child means is by observing interviewers giving tasks and by giving tasks himself, while under careful supervision.

The minimum amount of training required for interviewers to effectively utilize the SCAS Interview Protocols will be forty hours of intensive supervised instruction.

The training sequence for the interviewer will be composed of several distinct parts, these are briefly outlined below.

a. Memorization of the SCAS Interview Protocols will be accomplished by the trainees. This segment of the training is purely mechanical in nature. The trainee must learn the protocols so thoroughly that the questions and order of questions come naturally.

b. A brief introduction to the work of Jean Piaget and how it relates to the SCAS Interview Protocols will be presented to the trainees. This will provide a basis upon which to build understanding of the objectives of the SCAS Interview Protocols.

c. Video tapes and films of children being given tasks will be viewed by the trainees. These tapes and films will be instructive as to interview techniques and as to children's responses.

d. Training in correct interview procedrues will be constantly pursued. The subtleties of interview techniques, such as not leading the child, not talking too much, etc. will be emphasized throughout the training period.

e. Trainees will give tasks to experienced interviewers and to other workshop participants. These sessions will promote practice of the protocols.

f. The final phase of training will be devoted to practice using SCAS Interview Protocols with children under careful supervision by experienced interviewers. This portion of the training sequence is the most important. It is mandatory that the trainees give tasks to children in the presence of experienced interviewers so that errors may be defined and called to the attention of the trainees. Tape recordings will be made of these interviews so that the trainee may listen and help identify possible errors in his interview technique.

B. Schedule of Data Collection

The extent to which SCAS is applied in a given school system will depend upon the number of available personel to give individual interviews to children and to make classroom observations. These personnel must be available to attend a training workshop and to spend a large portion of their time collecting data for SCAS.

Few schools will be able to apply SCAS to <u>all</u> children involved in a science program, therefore, sampling techniques would be employed to select subjects for participation in SCAS. Ten or twelve children selected from a classroom of thirty would be an appropriate sample size. The subjects would be selected randomly and the classroom teacher would not be informed as to the identity of the subjects.

The subjects selected to participate in SCAS would be observed in their classroom during science lessons. The number of classroom observations would depend upon the length of the science program, the number of subjects involved, and the number of trained observers available.

In addition to classroom observations, the subjects would be individually interviewed by trained interviewers on several different occasions.

As an example, consider the sequence of events outlined below for the application of SCAS to a ten week science program. In this example, twelve children from each of fifteen classrooms would be involved making a total sample of 180 children.

1. Individual Interviews (Initial -- 1 week)

2. Classroom Observations (Initial -- 2 weeks -- 5 observations in each classroom)

3. No data collected (1 week)

4. Classroom Observations (2 weeks -- 5 observations in each classroom)

5. Individual Interviews (Mid-program -- 1 week -- no science lessons during this week)

6. Classroom Observations (2 weeks -- 5 observations in each classroom)

7. Individual Interviews (Final -- 1 week)

For the application of SCAS to the example above, nine interviewers and nine observers would be required. The same individuals <u>may</u> serve as interviewers and observers, but ideally there would be two separate teams of individuals.

C. Analysis of Data

Interview and classroom behavioral data collected by SCAS will provide a wide variety of possibilities for data analysis. Specific questions related to classroom behaviors of teachers and children can be answered quantitatively.

The relative amounts of time a teacher devotes to "encouragement" vs. "discouragement", giving "information" vs. "directors", "observing" students vs. "not observing" students, etc. can be described quantitatively. This is made possible by matrix analysis and computation of specific classroom behavioral "scores."

From interview data, each child can be described in terms of his responses to specific questions in uniformly administered tasks. In addition, the degree to which a child has used logical operations when confronted with various aspects of his environment will be recorded.

Relationships among variables will be investigated by means of suitable statistical methods (i.e., analysis of variance, regression techniques, scalogram analysis, etc.). Particular emphasis will be placed on identifying changes in logical operations associated with the child's view of his environment, the child's classroom behaviors, and the child's achievement with respect to program-specific objectives.

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